QA1, QA2, QB3   48+2 / 70   Statics → First

Palestine Technical University

Máen Qédan

Statics Test 1 (*This test carries 25% of the overall mark*) -

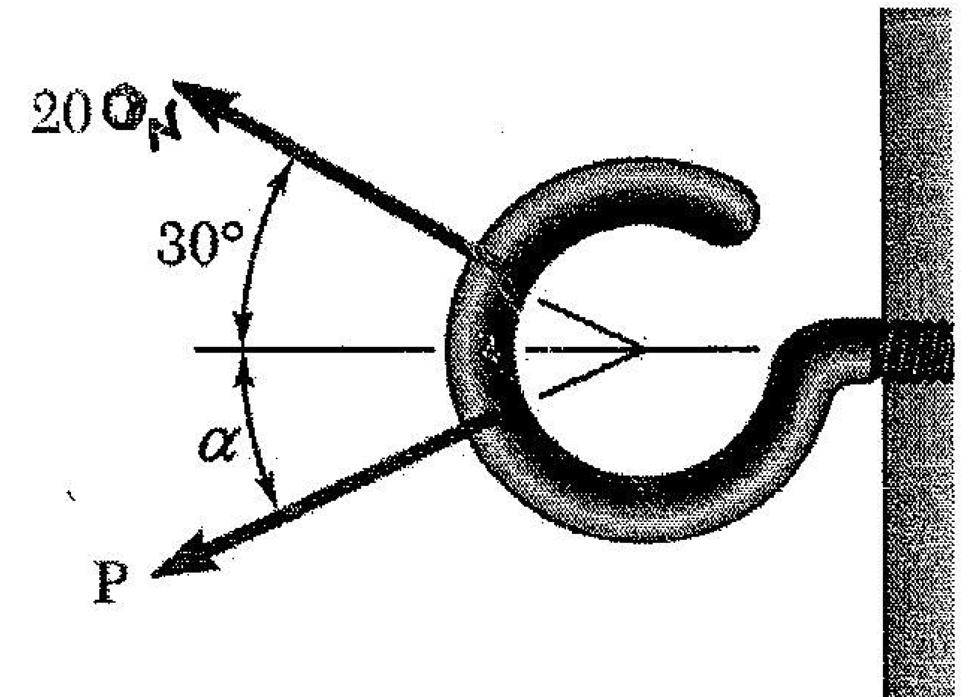
Your Name: معن نيدار قعدان
[redacted]
Group : ☐ Mechatronics ☒ Electrical

Attempt **2** questions from section A and only **2** questions from section B

Section A: Multiple Choice - You must show your working out   Date: 10.26.2010

QA1

Two forces are applied as shown to a hook support as shown. One of the forces is 200N and makes an angle of 30° with the horizontal while P makes an angle of α. Use trigonometry or otherwise, determine:



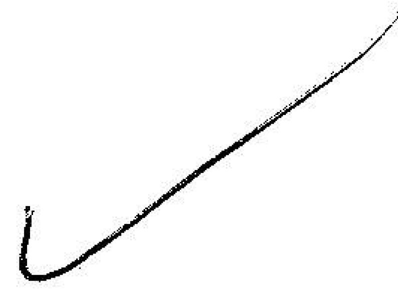
(a) The magnitude of the smallest force P for which the resultant R of the two forces applied to the support is horizontal, (b) the corresponding magnitude of R. Choose one of the following answers:

a) P=10 N, R = 17.32 N

b) P=100 N, R = 153.2 N

c) P=110 N, R = 173.2 N

d) P=100 N, R = 173.2 N



10/10

(20 marks)

Solution

(a)

∴ $\Sigma F_y = 0$ Smallest force ⇒ $\alpha = 90°$



$200 \sin 30 - P \sin \alpha = 0$

$200 \sin 30 = P \sin \alpha$ ⇒ $\alpha = 90°$

$100 = P \sin 90°$

∴ $P = 100$ N

10/10

(b)

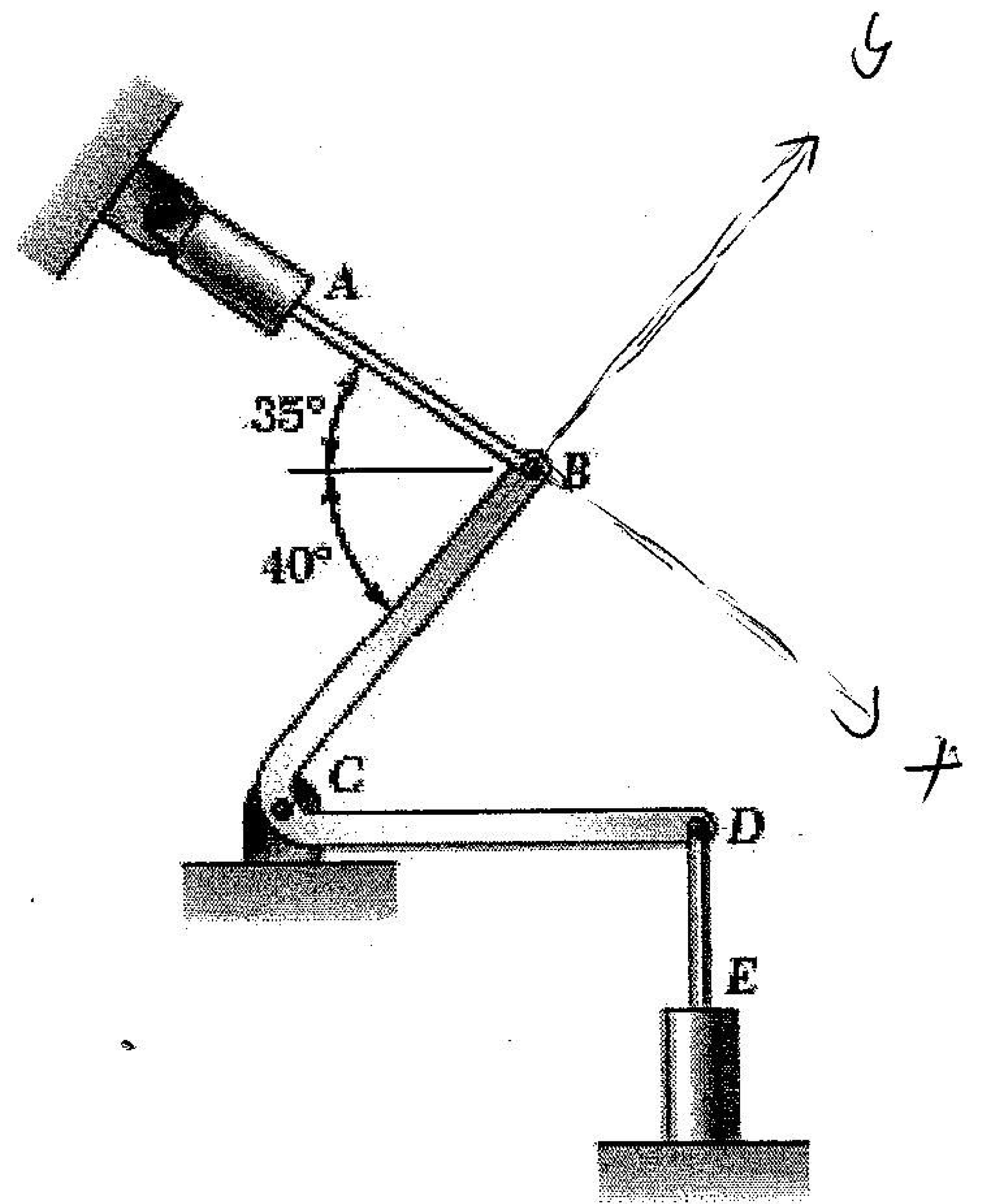
∴ $R = \Sigma F_x = 200 \cos 30 + 100 \cos 90°$

$= 200 (.866) + 0 = 173.2$ N

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QA2 (Section A)



Activator rod *AB* exerts on crank *BCD* a force **P** directed along line *AB*. Draw the FBD for members AB and BCD. Also, knowing that **P** must have a 250 N component perpendicular to arm *BC* of the crank, determine:

a) The magnitude of the force **P**,

b) Its component (P_{BC}) along *BC* *[assume BC is straight]*.

Select one answer from the following answers:

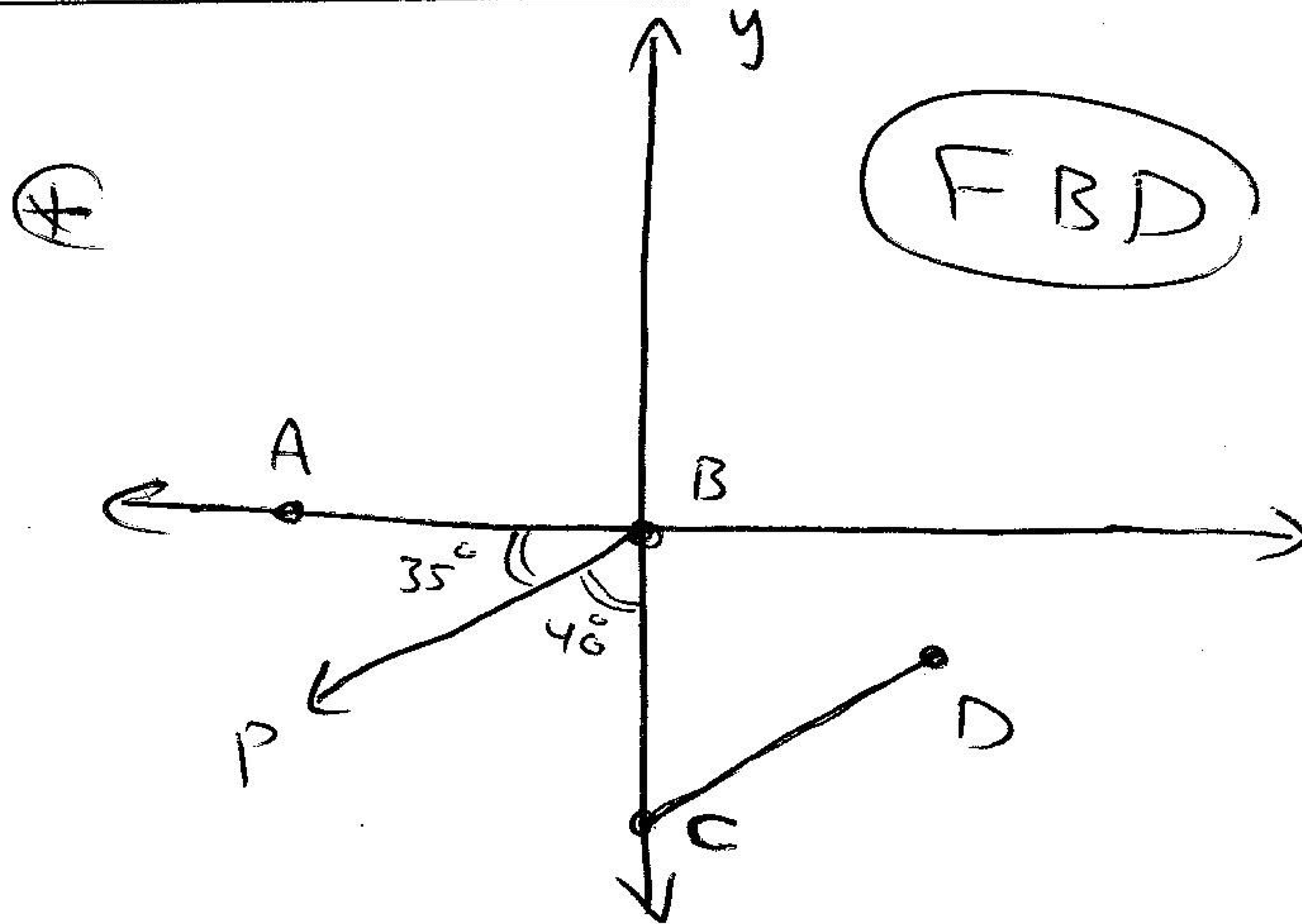
a) P = 25.9 N, P_{BC} = 57 N
b) P = 259 N, P_{BC} = 67 N
c) P = 239 N, P_{BC} = 6.7 N
d) P = 259 N, P_{BC} = 670 N

X 0/10

(20 marks)

Solution

FBD



?

0/20

Section B (You need to answer **ANY 2** questions only from this section)

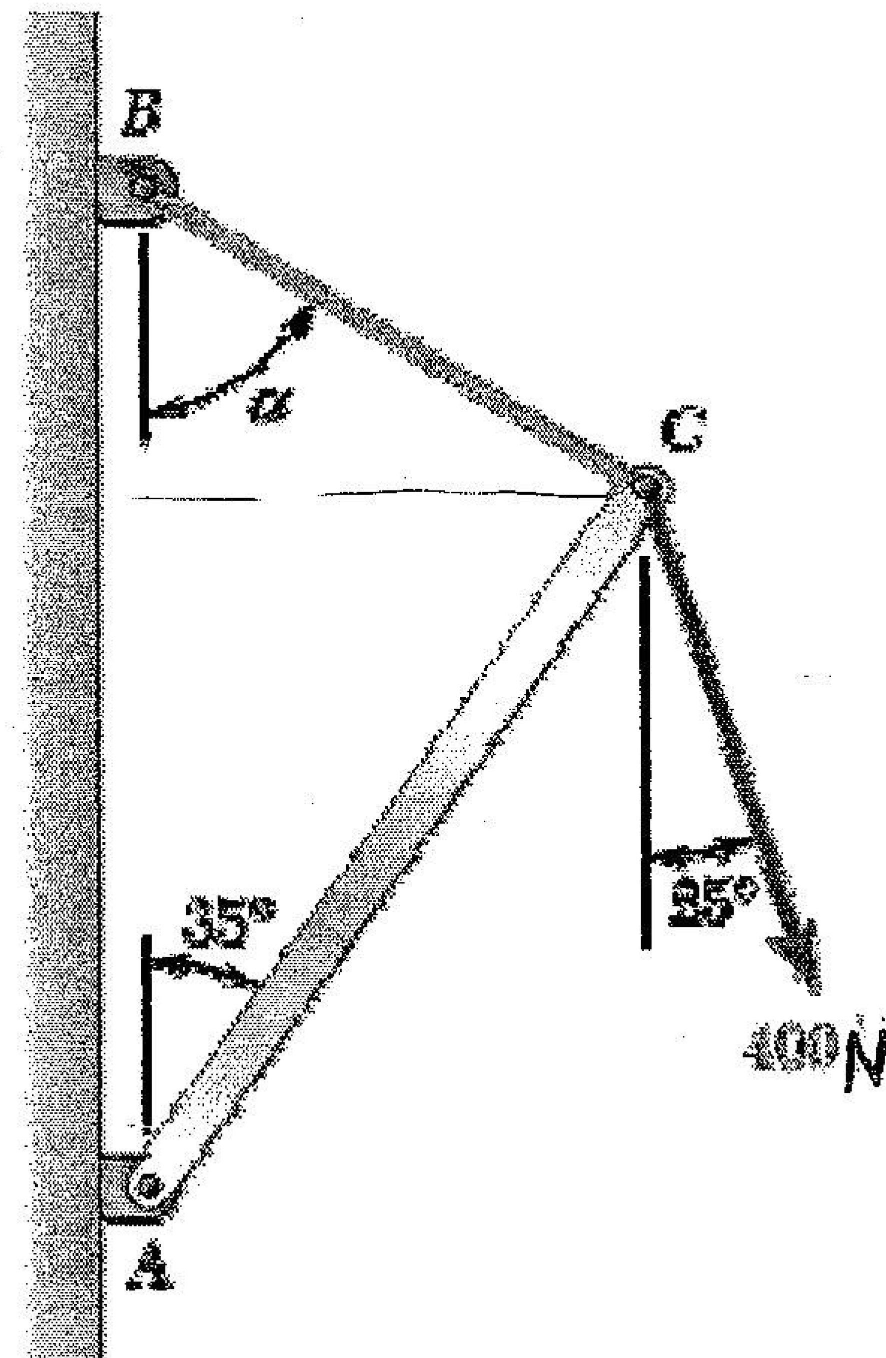
QB1

A uniform beam, AC, is held in the position, as shown in the diagram, by a cable BC which is inclined by an angle of $\alpha = 50°$ with the vertical. A force of 400 N is applied at point C, making an angle of 25° with the vertical. The pin at A exerts a force on AC directed a long line AC. For this system:

a) Sketch the Free Body Diagram of the beam AC showing ALL forces. **(5 marks)**

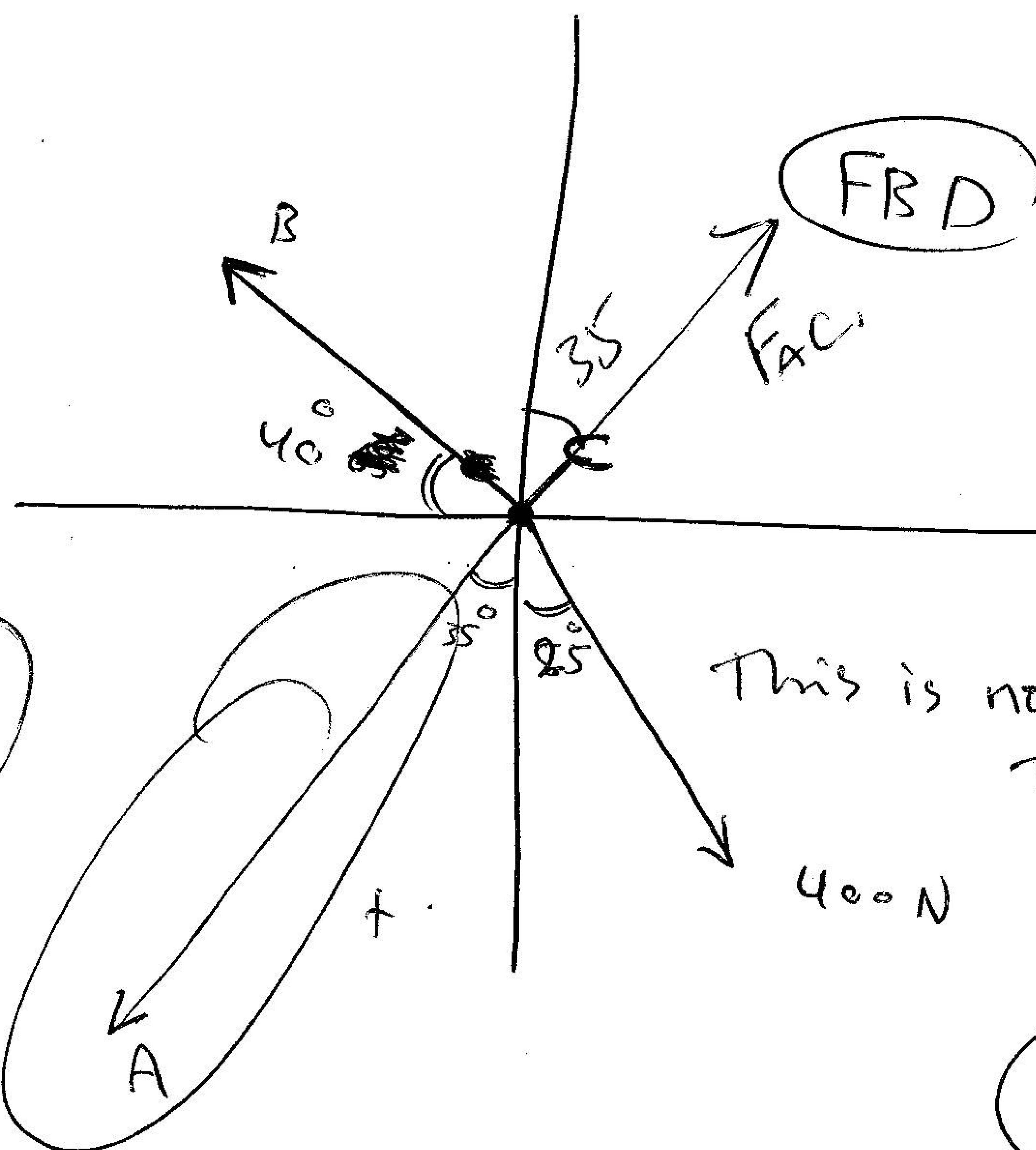
b) By using accurate drawing of forces (or otherwise), determine the magnitude of the force in AC **(15 marks)**

c) Find the tension in the cable BC **(10 marks)**



Solution

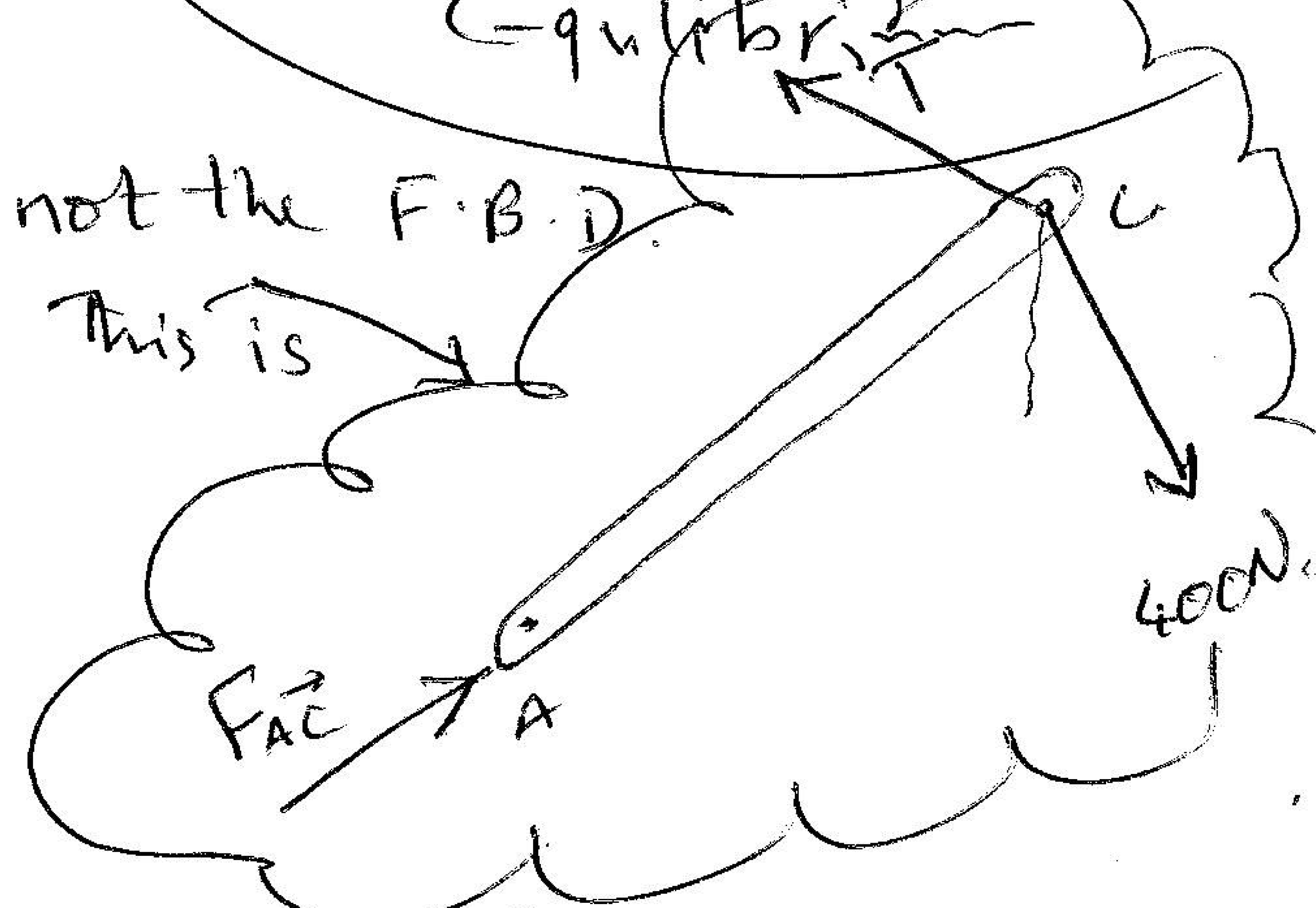
(a)



This system is in Equlibrium

This is not the F.B.D

This is



(b)

ΣF_x $-BC \cos 40 - AC \sin 35° + 400 \sin 25° = 0$

$-0.77\ BC - 0.57\ AC + 169 = 0$ —— ①

ΣF_y $BC \sin 40° - AC \cos 35° - 400 \cos 25° = 0$

$0.64\ BC - 0.82\ AC - 362.5 = 0$

$0.64\ BC - 0.82\ AC = 362.5$ —— ②

But $BC = \dfrac{362.5 + 0.82\ AC}{0.64}$

$BC = 566.4 + 1.28\ AC$

$\therefore \quad -0.77(566.4 + 1.28\,AC) - 0.57\,AC + 169 = 0$

$-436.1 - 0.98\,AC - 0.57\,AC + 169 = 0$

$-1.55\,AC - 267.1 = 0$

$1.55\,AC = -267.1 \Rightarrow AC = \frac{-267.1}{1.55}$

$= \boxed{-172.3\ N}$ ✗

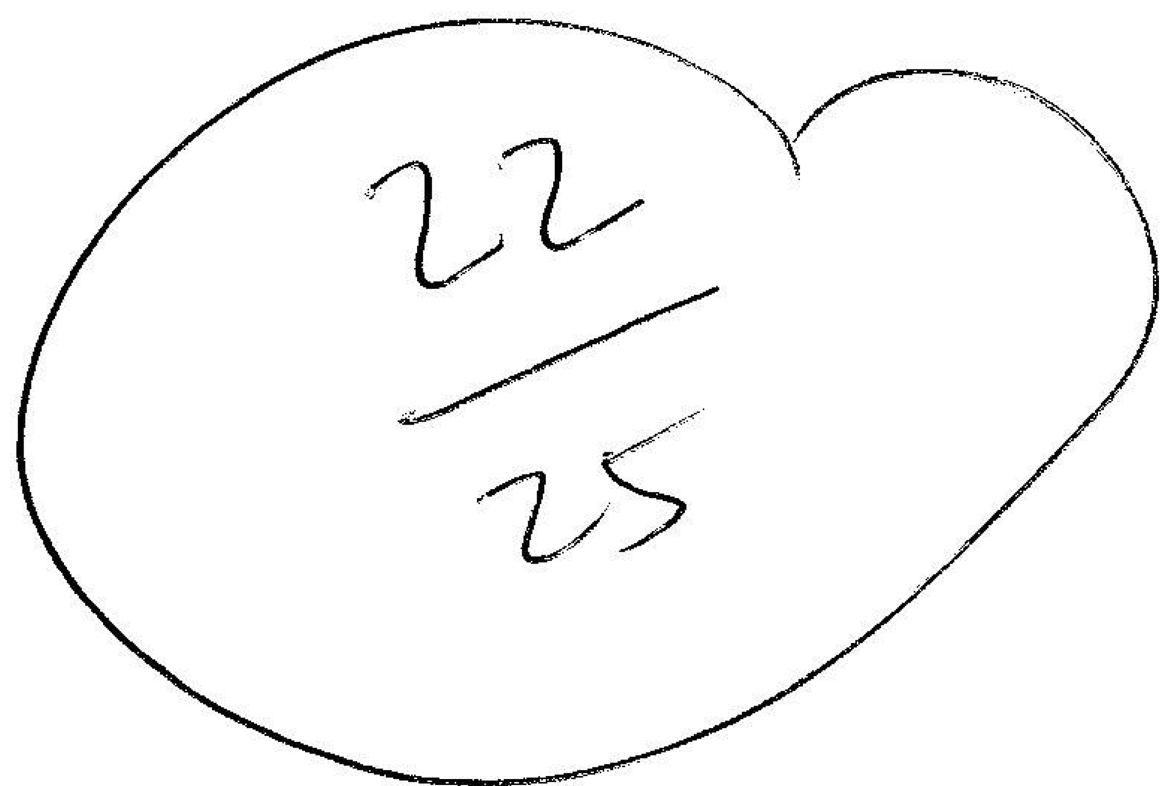
But F_{AC} is not in the -ve direction!

(c) $BC = 566.4 + 1.28(-172.3)$

$= 566.4 + (-220.5)$

$= \boxed{345.9\ N}$ ✗

Your workout could be right if you have chosen the correct direction for BC.



QB2

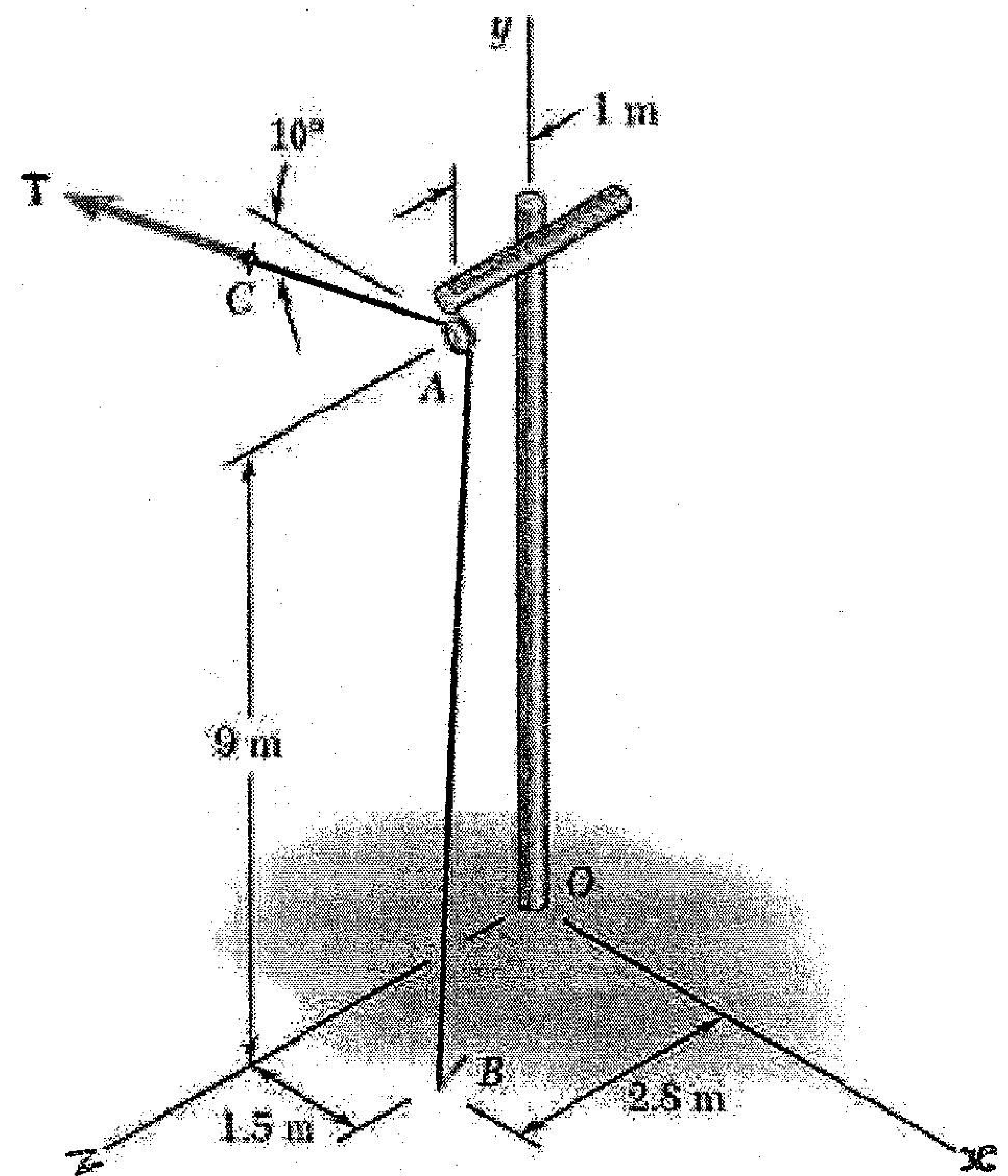
Before a telephone cable is strung, rope BAC is tied to the stake at B and is passed over a pulley at A as shown in the diagram. If part AC of the rope lies in the plane parallel to the xy-plane and that the tension (T) in the rope is 130 N, find the following:

a) The resultant force exerted on the pulley by the rope ends - in terms of the i, j & k

(15 marks)

b) The moment of this resultant about an axis through point O (again in terms of i, j, k).

(15 marks)



Solution

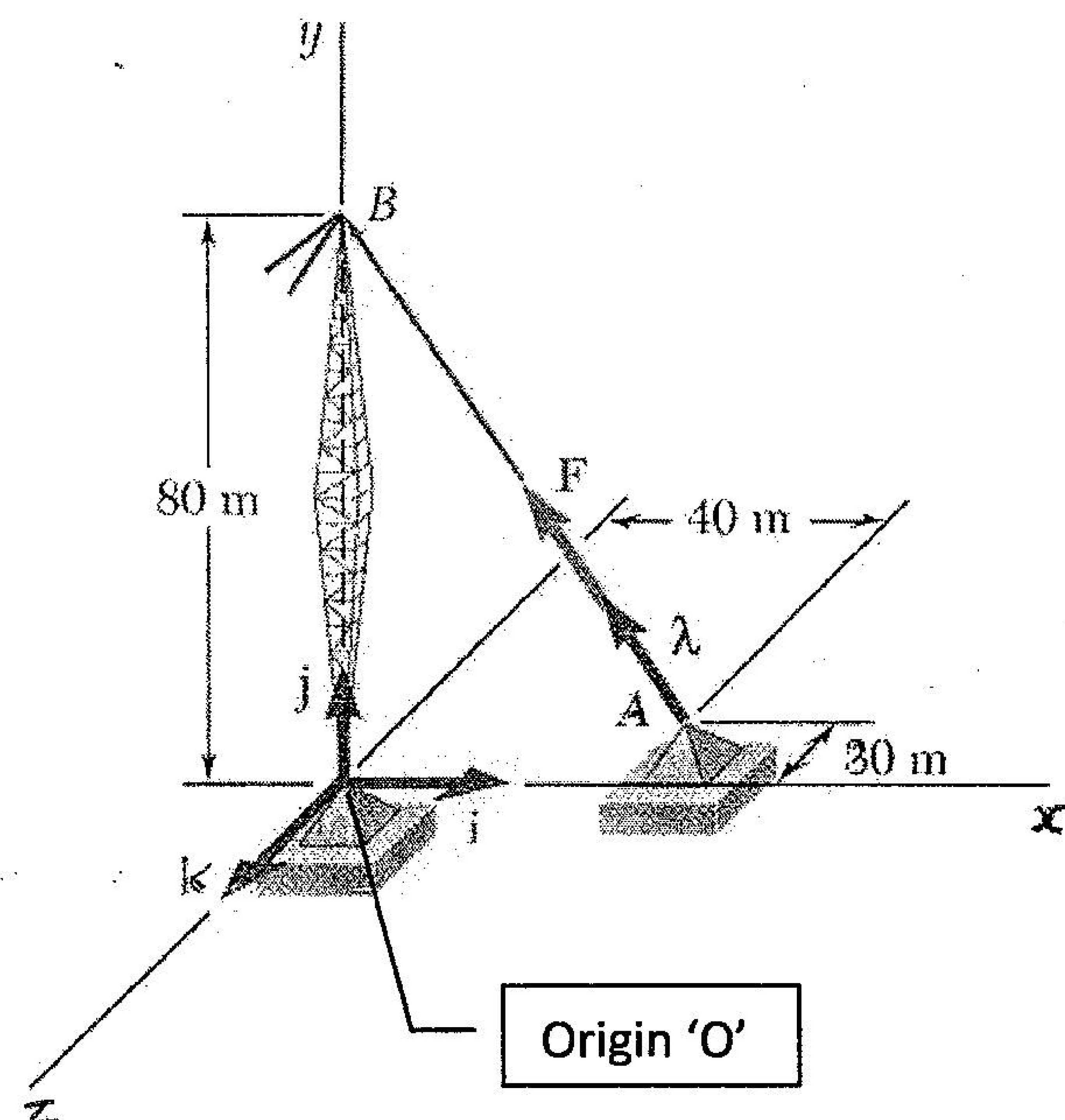
QB3

A winch tower, OB, is held vertically upwards by a system of 3 cables. The tower is supported at point (O) by a universal pin-joint while its top end (B) is held in position by the cables. The tension in cable BA is 3200 N.

Determine:

a) The components F_x, F_y, F_z of the force acting on the bolt at A *(in terms of i, j and k)* **(15 marks)**

b) The moment of the force (F) about the origin 'O' (in terms of i, j and k) **(15 marks)**



(a) $F = 3200$ N

$\vec{F} = \vec{\lambda} F$

$\vec{\lambda} = \frac{r_{B/A}}{|r_{B/A}|}$

$r_{B/A} = r_B - r_A = 80\hat{j} - (40\hat{i} - 30\hat{k})$

$= -40\hat{i} + 80\hat{j} + 30\hat{k}$ m

$|r_{B/A}| = \sqrt{(-40)^2 + (80)^2 + (30)^2} = \sqrt{1600 + 6400 + 900} = 94.3$ m

$\therefore \vec{\lambda} = \frac{-40\hat{i} + 80\hat{j} + 30\hat{k}}{94.3} = -0.42\hat{i} + 0.85\hat{j} + 0.32\hat{k}$

0.424

$\therefore \vec{F} = 3200(-0.42\hat{i} + 0.85\hat{j} + 0.32\hat{k})$

$= -1344\hat{i} + 2720\hat{j} + 1024\hat{k}$ N

1357 2713 1017.6

15/15

(b) $M_o = \vec{r} \times \vec{F}$ $\vec{r}_A = (40\hat{i} - 30\hat{k})$

$\therefore M_o = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 40 & 0 & -30 \\ -1344 & 2720 & 1024 \end{vmatrix}$

خلف الصفحة

$= \hat{i}(81600) - \hat{j}(40960 - (40320)) + \hat{k}(108800)$

$= \boxed{81600\hat{i} - 640\hat{j} + 108800\hat{k}}$ N.m

81408 $0\hat{j}$ 108544

if you were more accurate, you would have got the above results

$\frac{13+2}{15}$

